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STEELHEAD AND SEA-RUN CUTTHROAT TROUT LIFE HISTORY STUDY IN SOUTHEAST ALASKA

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ALASKA DEPARTMENT OF FISH AND GAME
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STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

STEELHEAD AND SEA-RUN CUTTHROAT TROUT LIFE HISTORY STUDY IN SOUTHEAST ALASKA

by

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ABSTRACT

Knowledge of the basic life history of Southeast Alaska steelhead, necessary to properly manage our native wild stocks, was not generally available prior to initiation of the steelhead life history study in 1971. This report covers the fifth year's operation of the project on the Petersburg Creek System, designed to study the life history of the steelhead trout, Salmo gairdneri Richardson, in a typical Southeast Alaska lake-stream system. Between April 24, 1975 and June 16, 1975 an estimated 326 adult steelhead migrated upstream past the Petersburg Creek weir. The peak of in-migration occurred on May 8, 1975. The out-migration of spawned out steelhead began on April 25, 1975, peaked on June 6, 1975, and was completed by July 24, 1975. The 1975 run of 326 adult steelhead is the lowest recorded number since initiation of the project in 1971. Age composition of the adult steelhead was determined from a total of 197 scale samples. The 1975 steelhead run to Petersburg Creek was comprised of 20 age classes with age classes 3.2, 3.3, and 4.2 comprising 54% of the total. Repeat spawning steelhead comprised 30.5% of the 1975 run to Petersburg Creek. Adult steelhead ranged in size from 60.4 cm and 2.3 kg to 97.0 cm and 9.1 kg with an overall average of 74.8 cm and 4.4 kg. Steelhead were found spawning throughout Petersburg Creek and its tributaries with redd site selection in the smaller tributaries more dependent on escape cover than on gravel size and water depth.

Surveys were conducted of five streams to assess their potential as sources of steelhead eggs. Weirs have been installed in two of these systems to secure eggs for brood stock development. In addition, foot surveys were conducted on four streams adjacent to the Sitka and Juneau road systems to assess their suitability for plants of hatchery reared steelhead smolts.

The out-migration of wild steelhead smolts from Petersburg Creek began on May 14, 1975, peaked on June 25, 1975, and was complete by July 18, 1975. A total of 502 smolts were enumerated during this period. This is the strongest wild smolt out-migration recorded since 1972. A total of 8,100 hatchery reared steelhead smolts were liberated in Petersburg Creek on June 10, 1975. This marks the first release of hatchery reared smolts in Southeast Alaska. A total of 64,772 fish of various species passed both upstream and downstream during operation of the Petersburg Creek weir in 1975.

BACKGROUND

Prior to initiating the steelhead project in 1971, only limited research had been conducted on the life history of this fine sport fish in Alaska. Hence, most of the effort during the past five years has been spent working toward a better understanding of their basic life history.

Petersburg Creek was selected as a study site due to its location and adequate population of steelhead. Since 1971, the number of steelhead, their age, size, frequency of spawning, and spawning and rearing requirements have mostly been determined for Petersburg Creek.

The steelhead population in Petersburg Creek is composed of many age classes, with as high as 40% of the run made up of repeat spawners. These findings have resulted in management procedures aimed at preserving the quality angling that now exists throughout much of Southeast Alaska.

Studies of the rearing habits and requirements of young steelhead have shown that these fish are slow growing and are dependant upon small side tributary streams throughout much of their stream residence. With these findings, recommendations to protect these small stream environments can be made to agencies planning land use activities within steelhead producing watersheds.

The use of hatchery reared steelhead to supplement or create new runs of steelhead is a way of life throughout much of the Pacific Northwest. With completion of the Crystal Lake Hatchery in 1972, a limited program of steelhead production was initiated in Alaska. The first plant of steelhead smolts was made in 1975 with subsequent releases to follow. Results of these introductions will not be available until 1977 when the first adults return.

RECOMMENDATIONS

Research

The determination of the timing and numbers of in- and out-migrant adult steelhead, their length, weight, sex, and age should be continued for the Petersburg Creek system.

Additional information on the survival of Petersburg Creek steelhead smolts to adults is needed to adequately formulate guidelines for future management work.

Investigation should begin on the ecological relationships between steelhead-cutthroat, Dolly Varden, and coho salmon young.

Special emphasis should be given to streams selected for experimental stocking of steelhead smolts.

The experimental release of hatchery reared steelhead smolts in Petersburg Creek to determine smolt survival and subsequent smolt to adult returns should continue.

Surveys of potential steelhead egg take sites should be continued.

Investigations identifying the limiting factors on natural production of steelhead smolt should be continued.

Management

Much of the life history of the spring run steelhead in Southeast Alaska has been determined from the ongoing research program. However, some important aspects important to their management still remain unknown.

The Crystal Lake Hatchery is presently rearing 30,000 steelhead. These steelhead will be marked and released in three separate locations. Crystal Creek will receive 15,000 steelhead smolts as part of the continuing program to establish a brood stock at the hatchery. Petersburg Creek will receive 7,500 smolts to continue a program designed to establish guidelines for stocking rates and optimum release dates. The remaining 7,500 smolts will be planted in Montana Creek, adjacent to the Juneau road system. Montana Creek, at present, does not support a native population of steelhead and this will be the initial attempt to create a sport fishery for steelhead. Montana Creek will be monitored closely to determine the success of the plant and to provide data for additional plants of hatchery produced steelhead.

Additional management work needs to be undertaken to determine the best brood stocks, type of streams best suited for supplemental production, the type of rearing facilities (pond, freshwater or saltwater pens), and the influence of hatchery fish on native fish. Many of the above can not be answered in one season, and will require several years of study together with a thorough literature review of similar programs conducted throughout the Pacific Northwest.

To continue existing programs, the procurement of 250,000 spring run steelhead eggs is planned for the spring of 1976. At present, plans call for obtaining these eggs from streams adjacent to the Mitkof Highway and Petersburg Creek.

Angler effort as well as land use practices such as logging are increasing at a rapid rate on some of the better steelhead streams of Southeast Alaska. Clear cut logging has inpacted many good streams and will probably continue to effect steelhead habitat. The most apparent result of this activity is the loss of aesthetics of the area. Other immediate impacts of logging include the increased use of these streams due to ease of access by the anglers living in logging camps. Long term results are as yet unknown for Alaska, however, they have been determined for conditions present in Oregon and Washington. In view of increased fishing pressure and habitat alterations, some of our remaining streams should be set aside as recreation areas (land classification) and the type of access to these areas limited. A stream management plan should be put into effect to protect the existing wild steelhead populations.

OBJECTIVES

1. Determine the number, length, weight, sex and age of in- and out-migrant adult steelhead in the Petersburg Creek system.

2. Determine the distribution of spawning steelhead within the Petersburg Creek system.

3. Determine the number, length and age of wild steelhead smolt leaving the Petersburg Creek system.

4. Determine the feasibility of stocking hatchery-reared steelhead smolts in the Petersburg Creek system.

5. Locate system other than Petersburg Creek for potential steelhead egg take sites.

6. Determine systems suitable for future stocking of hatchery-reared steelhead smolt.

7. Determine the distribution and habitat requirements of rearing steelhead young within the Petersburg Creek system.

8. Continue compilation of the annotated bibliography of selected references on steelhead.

TECHNIQUES USED

Background information from prior studies conducted by the Alaska Department of Fish and Game and other agencies was reviewed.

The horse and deck weir, incorporating in- and out-migrant traps, constructed in 1972, required major reconstruction which was not completed until April 23, 1975.

The completed weir was 50 meters long and .91 meters high. An additional .91 meters of height was added to compensate for the higher high tides by addition of screens mounted above the weir deck. The weir was of an inclined screen panel type, using 1.60 cm hardware cloth screens for normal water levels and 2.54 cm hareware cloth screens during high water periods. Three traps, 3.6 meters by 2.7 meters, were placed near the east bank, as this area has been determined to be the most attractive to migrating fish. The three traps were designed to be used as either in- or out-migrant traps depending upon the direction of the bulk of the migrating fish. A three-meter weir section, located in midstream, was modified to allow boat traffic to pass through the weir. All in- and out-migrant adult steelhead captured at the weir were enumerated, anesthetized with Tricaine Mehtanesulfonate (MS-222), sexed, measured, and weighed. All in-imgrant adult steelhead were marked by punching a hole in the right opercule. Scale samples were collected from all in- and out-imgrant steelhead for total age determinations. The sampled steelhead were then placed in a freshwater tank to recover before being released in the direction of original migration.

To estimate the total in-migration of adult steelhead to Petersburg Creek, a marked to unmarked ratio of the out-migrants (Baily's modification of Peterson's formula: Ricker, 1958) was used. The estimated total in-migrant of adult steelhead was computed as follows:

$$N = \frac{M(C+1)}{R+1} = \frac{135(124)}{60} = 279$$

Where M = steelhead marked on their in-migration

C = total number of steelhead captured on their out-migration

R = numbers of marked steelhead captured on their out-migration

All out-migrant steelhead smolts captured at the weir were anesthetized with MS-222, enumerated and measured, and examined for fin clips. Smolts found dead of natural causes were sampled for stomach contents and their otoliths were collected for age deter ination.

Foot surveys and sampling by hook and line were used to determine the location and distribution of spawning steelhead in the Petersburg Creek system.

Selected streams other than Petersburg Creek were foot surveyed and sampled by hook and line to assess their potential as steelhead egg-take sites. Selected streams were also surveyed by foot to determine their suitability for plants of hatchery reared steelhead smolts.

The in- and out-migration of sea-run cutthroat, Salmo clarki Richardson, Dolly Varden, Salvelinus malma (Walbaum), and the enumeration of the various salmon, Oncorhynchus sp., was achieved by removing the fish from the traps by dip net, or removing a weir screen and tally counting as they crossed a "flash board."

FINDINGS

Adult Steelhead - Numbers and Timing

The total in-migration of adult steelhead, Salmo gairdneri, to Petersburg Creek in 1975 was estimated to be 326 fish. A comprehensive creel census of the steelhead anglers on Petersburg Creek was conducted from April through June 1975. A total of 183 anglers were censused; they fished a total of 841 hours to harvest 47 steelhead, the lowest number recorded during any year since initiation of the census in 1971.

The 1975 in-migration of 326 adult steelhead to Petersburg Creek is the lowest recorded since initiation of the project in 1971 (Table 1).

Table 1. Estimated Adult Steelhead Run to Petersburg Creek, 1971-1975.

Year	Estimated No Adult Steelhead
1971	806
1972	536
1973	401
1974	369
1975	326

Examination of Table 1 shows a steady decline in adult steelhead numbers during the past five years. Exact causes for the decline are not known. Fishermen harvest has not increased, in fact it has declined from the average of 70 in 1972 and 1973 to 47 in 1975. Operation of the research facility has had some inevitable effect on the total run; however, the impact is probably not great, as the precentage of repeat spawners in the total run has remained high. Enumeration of other salmonids in Petersburg Creek has indicated a steady decline in the abundance of those species that rear for any length of time in the Petersburg Creek system. With the exception of the Dolly Varden, the remaining rearing species, i.e. steelhead, cutthroat, red salmon, and coho salmon, have shown a steady decline since 1971.

The in-migration of adult steelhead to Petersburg Creek probably began some time in late February or early March, before the research weir was complete. The enumerated in-migration of adult steelhead to Petersburg Creek began on April 25, peaked on May 8, and was complete on June 16, 1975.

In-migrant patterns for adult steelhead in 1975 closely paralled migration timing recorded in previous years. (Jones 1972; 1973; 1974; 1975).

The out-migration of spent adult steelhead from Petersburg Creek began on April 25, peaked on June 6, and was complete by July 24, 1975. To avoid delaying the steelhead adult out-migration, a beach seine was employed to capture the steelhead for release below the weir. Presented in Table 2 are the bi-weekly migration totals for adult steelhead actually counted as they passed the Petersburg Creek weir in 1975.

Table 2. Adult Steelhead Trapped During Bi-weekly Periods, Petersburg Creek Weir 1975.

Bi-weekly	Direction of Migration	
Period	In-migrants	Out-migrants
4/21 - 5/4	21	1
5/5 - 5/18	65	2
5/19 - 6/1	40	19
6/2 - 6/15	8	50
6/16 - 6/29	1	25
6/30 - 7/13	0	24
7/14 - 7/27	0	1
Total:	135	122

Adult Steelhead Age - Sex Relationships

To obtain the age-sex relationships of the Petersburg Creek steelhead run, scale samples were collected and sex determined from all adult steelhead trapped at the weir during their in- and out-migrations. A total of 197 scales were readable for total age determinations.

Twenty age classes (ages 2.1s - 5.2) were found among the Petersburg Creek steelhead population in 1975 (Table 3). The 20 age classes recorded in 1975 are the lowest number noted since initiation of the study in 1971. Examination of age classes from previous years showed that steelhead in several of the repeat spawning age classes were missing from the 1975 run.

Age classes are presented using the aging method described by Narver and Withler, 1971. Repeat spawners are listed with an "s" after ocean age. This "s" represents a spawning run and is added to the total to determine the overall total age of repeat spawners. For example, a steelhead with an age of 4.1s is a total of six years old at the time the sample was obtained. This steelhead spent four years rearing in Petersburg Creek before migrating to sea as a smolt. It then matured for one winter and two summers before returning to Petersburg Creek to spawn for the first time. It survived its initial spawning run and returned on its second spawning run to Petersburg Creek, to be sampled prior to spawning just as it was entering its seventh year of life. If this steelhead survives its second spawning run and returns in 1976, a second "s" will be added to its total age. Initial spawning steelhead are those fish without an "s" in their total age designation.

Adult steelhead sampled in 1975 had spent two (7.1%), three (59.4%), four (32.9%), and five (0.6%) winters in fresh water before migrating to sea.

Presented in Table 4 are the freshwater ages of steelhead adults sampled from Petersburg Creek from 1971 through 1975. The freshwater ages of the 1975 run continue the trend toward older aged smolts comprising the majority of the population.

Table 3. Steelhead Trout Age Classes, Petersburg Creek - 1975

Age Class	No. SH	No. of Females	No. of Males	Percent of Total
2.1s	1	0	1	0.5
2.2s	3	1	2	1.5
2.2ss	2	2	0	1.0
2.3	8	4	4	4.1
3.1s	17	6	11	8.6
3.1ss	2	1	1	1.0
3.1sss	2	1	1	1.0
3.2	36	11	25	18.3
3.2s	15	12	3	7.6
3.2ss	3	2	1	1.5

Table 3. (Con't) Steelhead Trout Age Classes, Petersburg Creek - 1975

3.2ssss	2	2	0	1.0
3.3	40	31	9	20.3
4.1s	7	3	4	3.6
4.1ss	1	0	1	0.5
4.1sss	1	1	0	0.5
4.2	31	8	23	15.7
4.2s	3	3	0	1.5
4.2sss	1	1	0	0.5
4.3	21	19	2	10.7
5.2	1	0	1	0.5
Total	197	108	89	99.9

Table 4. Freshwater Ages of Steelhead Adults, Petersburg Creek, 1971-1975

Year	Two	Three	Four	Five	Sample Size
1971	27.5%	56.8%	15.7	0	280
1972	13.1%	60.4%	24.9	1.1%	170
1973	11.3%	67.3%	20.7	0.7%	266
1974	4.1%	64.5%	31.6	0.7%	275
1975	7.1%	59.4%	32.9	0.6%	197

Steelhead Frequency of Spawning

Examination of the scale samples collected from the 1975 Petersburg Creek steelhead run, revealed that 69.5% of the total run were initial spawners and that 30.5% of the run showed one or more spawning checks on their scales. The number of years 1975 sampled steelhead spawned is presented in Table 5.

Table 5. Steelhead Trout Spawning Frequency, Petersburg Creek, 1975

	Number of Years Adult Steelhead Returned to Spawn.					
Sex	One	Two	Three	Four	Five	Totals
Male	64	21	3	1	0	89
Female	73	25	5	3	2	108
Totals	137	46	8	4	2	197

These steelhead were from six age classes with Age Class 3.3 the most numerous for all fish examined (Table 6). Age Classes 2.2 and 3.4 steelhead, which have occurred in previous years runs, were absent from the 1975 run. Since initiation of the project in 1971, over 55% of all initial steelhead spawners were in age classes 3.2 and 3.3. (Jones 1972; 1973; 1974; 1975).

The 1975 run of steelhead to Petersburg Creek contained 49.6% two ocean fish. This compares favorably with the 50.9% two ocean fish recorded in 1974. (Jones 1975).

The sex ratio of inital spawners was 1.14:1 with females only slightly more numerous than males.

The percentage of repeat spawners in the total run (30.5%), is the lowest recorded since the study was initiated in 1971. (Table 7).

Table 6. Age Classes of Initial Steelhead Trout Spawners by Sex, Petersburg Creek Weir, 1975.

Age Class	No. SH	No. of Females	No. of Males	Percentage of Total
2.3	8	4	4	5.8
3.2	36	11	25	26.3
3.3	40	31	9	29.2
4.2	31	8	23	22.6
4.3	21	19	2	15.3
5.2	1	0	1	0.7
Total	137	73	64	99.9

Table 7. Percent Repeat Spawners, Petersburg Creek - 1971-1975

Year	Percent Repeat Spawners
1971	43.0%
1972	43.7%
1973	41.7%
1974	32.7%
1975	30.5%

Fourteen age classes were represented among the repeat spawners in 1975 with the majority of the males in Age Class 3.1s and the majority of the females in Age Class 3.2s (Table 8). Repeat steelhead spawners by sex show females to outnumber males by a 1.4:1 ratio. Of the 35 repeat spawning females, 25 (71.4%) were spawning for the second time, five (14.3%) for the third time, three (8.5%) for the fourth time and, two (5.7%) for the fifth time. Of the 25 repeat spawning males, 21 (84.0%) were spawning for the second time, three (12%) for the third time and one (4.0%) for the fourth time.

Table 8. Age Classes of Repeat Steelhead Trout Spawners by Sex. Petersburg Creek, 1975.

Age Class	No. SH	No. of Females	No. of Males	Percentage of Total
2.1s	1	0	1	1.7
2.2s	3	1	2	5.0
2.2ss	2	2	0	3.3
3.1s	17	6	11	28.3
3.1ss	2	1	1	3.3
3.1sss	2	1	1	3.3
3.2s	15	12	3	25.0
3.2ss	3	2	1	5.0
3.2ssss	2	2	0	3.3

Table 8. (Con't) Age Classes of Repeat Steelhead Trout Spawners by Sex. Petersburg Creek, 1975.

	4.1s	7	3	4	11.7
	4.1ss	1	0	1	1.7
	4.1sss	1	1	0	1.7
	4.2s	3	3	0	5.0
	4.2ssss	1	1	0	1.7
Total	14	60	35	25	100.0

Steelhead Length - Weight Relationships

Length-weight relationships were collected from 197 steelhead as they passed the Petersburg Creek weir in 1975. Average lengths and weights of initial spawners did not differ by sex and therefore are combined for presentation. The large differences in size occurred between initial and repeat spawners as a group (Table 9).

Table 9. Steelhead Trout Length-Weight Relationships, Petersburg Creek 1975.

		Fork Length			
	No. In Sample	Range in cm	Mean Fork Length	Weight Range in kg	Mean Weight in kg.
Initial Spawners	137	60.4-92.7	72.7	2.3-7.9	4.0
Repeat Spawners	60	66.0-97.0	79.4	2.8-9.1	5.2
Total	197	60.4-97.0	76.0	2.3-9.1	4.6

The five year length-weight averages for initial and repeat spawners sampled at Petersburg Creek are presented in Table 10.

Table 10. Steelhead Trout Length-Weight Relationships, Petersburg Creek 1971-1975.

Year		No. in Sample	Mean Length in cm	Mean Weight in kg
1971	Initial Spawners	158	74.6	4.3
	Repeat Spawners	122	85.3	6.2
1972	Initial	219	74.4	4.0
	Repeat	170	82.3	5.5
1973	Initial	155	76.3	4.9
	Repeat	111	83.1	6.8
1974	Initial	185	74.4	4.3
	Repeat	90	85.9	6.3
1975	Initial	137	72.7	4.0
	Repeat	60	79.4	5.2
5 year Average	Initial	170	74.4	4.3
	Repeat	110	83.2	6.0

Steelhead Spawning Requirements and Spawning Areas

Observations of steelhead spawning requirements and spawning areas in the Petersburg Creek System have been made on an annual basis starting 1971.

Steelhead have been observed spawning virtually throughout the main stem of Petersburg Creek from the upper inter-tidal area to Petersburg Lake. Steelhead have been observed spawning in 7 of the larger tributaries of Petersburg Creek (Figure 1) with fish ascending to the upper limits of several tributaries. Only one pair of adult steelhead have been observed spawning in Petersburg Creek above Petersburg Lake even though excellent spawning sites are available in this area.

Areas selected by Petersburg Creek steelhead for redd sites in the main stem of Petersburg Creek were described by Jones 1975. Observations of steelhead redd sites in the smaller tributary streams showed a preference for gravel areas closely associated with some type of cover. These sites were usually in water less than 20 cm in depth with gravel 5-8 cm

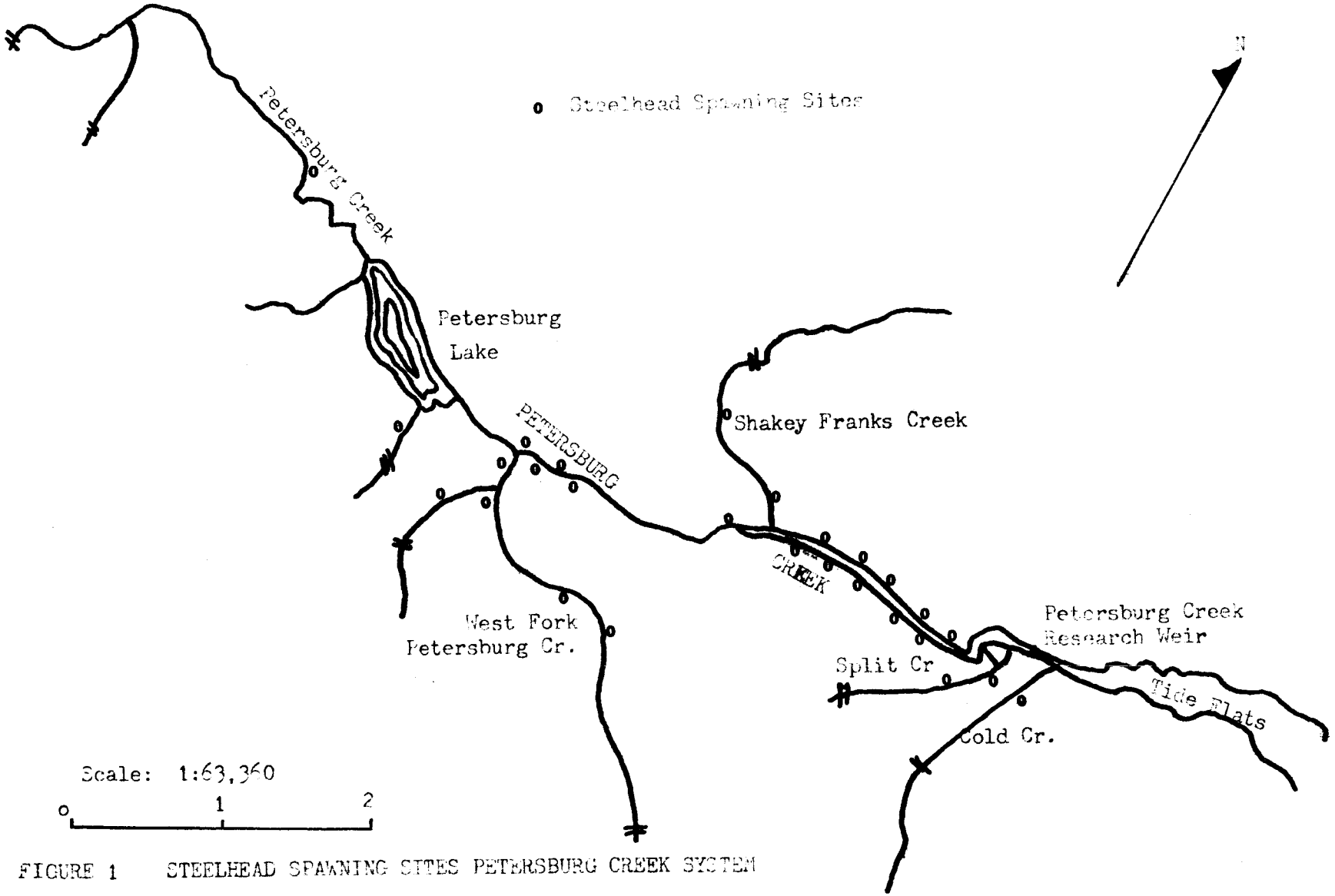

FIGURE 1 STEELHEAD SPAWNING SITES PETERSBURG CREEK SYSTEM

in diameter. It would appear that adequate cover to escape possible predation is the single most important factor in redd site selection in the small tributary streams. Most tributary stream spawning sites appear to be of marginal quality and are used by less than 10% of the total spawning population.

During 1975 an estimated 179 female steelhead spawned above the weir in Petersburg Creek. Fecundity counts have been made of adult female steelhead on an annual basis since 1973. The average fecundity for all fish sampled has been 5,286 eggs per female. An estimated total of 946,194 steelhead eggs were spawned in Petersburg Creek during 1975. In addition, 47,574 steelhead eggs were artificially spawned and placed in the Crystal Lake Hatchery for incubation.

Stream Residency - Adult Steelhead

Studies of stream residency for Petersburg Creek steelhead were conducted during the 1973 and 1974 field seasons. To conduct these studies, adult steelhead were tagged with numbered "Floy" type anchor tags during their up-stream migration. Recapture of the tagged steelhead on their out-migration established length of stream residency. Stream residency was found to average 26 1/2 days in 1973 (Jones 1974) and 30 days in 1974, (Jones 1975).

It is suspected that use of the highly visible "Floy" tags caused tagged steelhead to suffer a higher mortality rate from predation than untagged fish. As Adult steelhead runs to Petersburg Creek have been on a steady decline, it was deemed unwise to continue tagging adults as there apparently are only slight differences in length of stream residency from year to year.

Steelhead Egg Take Site Investigations

Surveys of streams, other than Petersburg Creek, as potential sources of steelhead eggs have been conducted annually starting in 1973. To date a total of five stream systems have been surveyed. Three of these streams are adjacent to the Mitkof Highway. Ohmer Creek, Blind River and Falls Creek were surveyed in 1973 and picket weirs were constructed on all three during the spring of 1974. High water during May 1974 destroyed the Ohmer Creek and Falls Creek weir and did some damage to the Blind River weir. Manpower limitations prevented reconstruction of these weirs so the 1974 steelhead egg take was limited to a few from Blind River; the rest were supplied from Petersburg Creek stock.

During the spring of 1975 the weir on Falls Creek was rebuilt and it together with the Blind River weir supplied 75% of the steelhead eggs placed in the Crystal Lake Hatchery. Twenty-five percent of the eggs taken in 1975 were from Petersburg Creek steelhead. From work completed to date, it appears that of the streams adjacent to the Mitkof Highway, only Falls Creek has the potential to supply steelhead eggs on an annual basis.

Kadake Creek, located on the northeast end of Kuiu Island, was surveyed during the spring of 1975. Kadake Creek is the largest system on Kuiu Island and supports an excellent run of spring steelhead. Surveys made in 1975 and observations of Kadake Creek in previous years indicate that this system would not lend itself to egg take operations due to the large watershed and its remote location.

Plotnikof Creek, located in Port Banks, Baronof Island, was surveyed during July 1974. The Plotnikof system contains the only known population of summer run steelhead in Southeast Alaska. The July timing of the summer run steelhead entry into fresh water makes it a highly desirable sport species.

Physical surveys of the two inlet streams to Plotnikof Lake determined that both contained good sites for weir construction. The only limiting factor would be the logistics involved in transportating the weir materials to the site. When funds become available, this site will undoubtedly be developed as a source for brood stock for the Crystal Lake Hatchery.

Stream Surveys - Hatchery Reared Steelhead Smolt Plants

During 1975, four stream systems were surveyed to determine suitability for plants of hatchery reared steelhead smolts. Two streams were adjacent to the Juneau road system and two were close to Sitka. The two Juneau area streams, Cowee Creek, and Montana Creek, were surveyed on August 12, 1975 to assess their potential for plants of hatchery reared steelhead. Fisherman accessibility and steelhead holding water were the primary criteria.

Cowee Creek heads in a small glacier and flows about 13 kilometers to the south end of Berners Bay. (Figure 2). The area from approximately 1.5 kilometers above to three kilometers below the Glacier Highway was walked during the survey. This area is accessible from the road by a fairly good foot trail on the north side of the river. This trail starts at the junction of Davis Creek above the highway bridge and runs out on the tide flats below the highway. The section of Cowee Creek which was surveyed is used by anglers fishing for Dolly Varden and coho salmon. There are eight to ten good holding areas for steelhead in the area surveyed (Figure 2). Cowee Creek was fairly glacial in color during the survey. However, during steelhead time (April-June), this creek should show less glacial color which would ease angling.

Montana Creek heads in a high mountain valley and flows approximately 19 kilometers to join the Mendenhall River. Montana Creek was foot-surveyed in the area adjacent to the Glacier Loop Highway and the Montana Creek Road (Figure 3). Montana Creek Road parallels the stream for over three kilometers and affords excellent fisherman access. The stream adjacent to the Montana Creek Road is comprised of rapids and numerous deep holes. The upper area of Montana Creek appears to contain many excellent holding areas for steelhead. The section of Montana Creek near the Glacier Loop Road is slow flowing with overgrown banks and many deep areas. This portion appears to contain excellent steelhead holding water even though it may be difficult to fish due to the heavy stream bank cover. The mouth of Montana Creek is accessible via a foot trail running

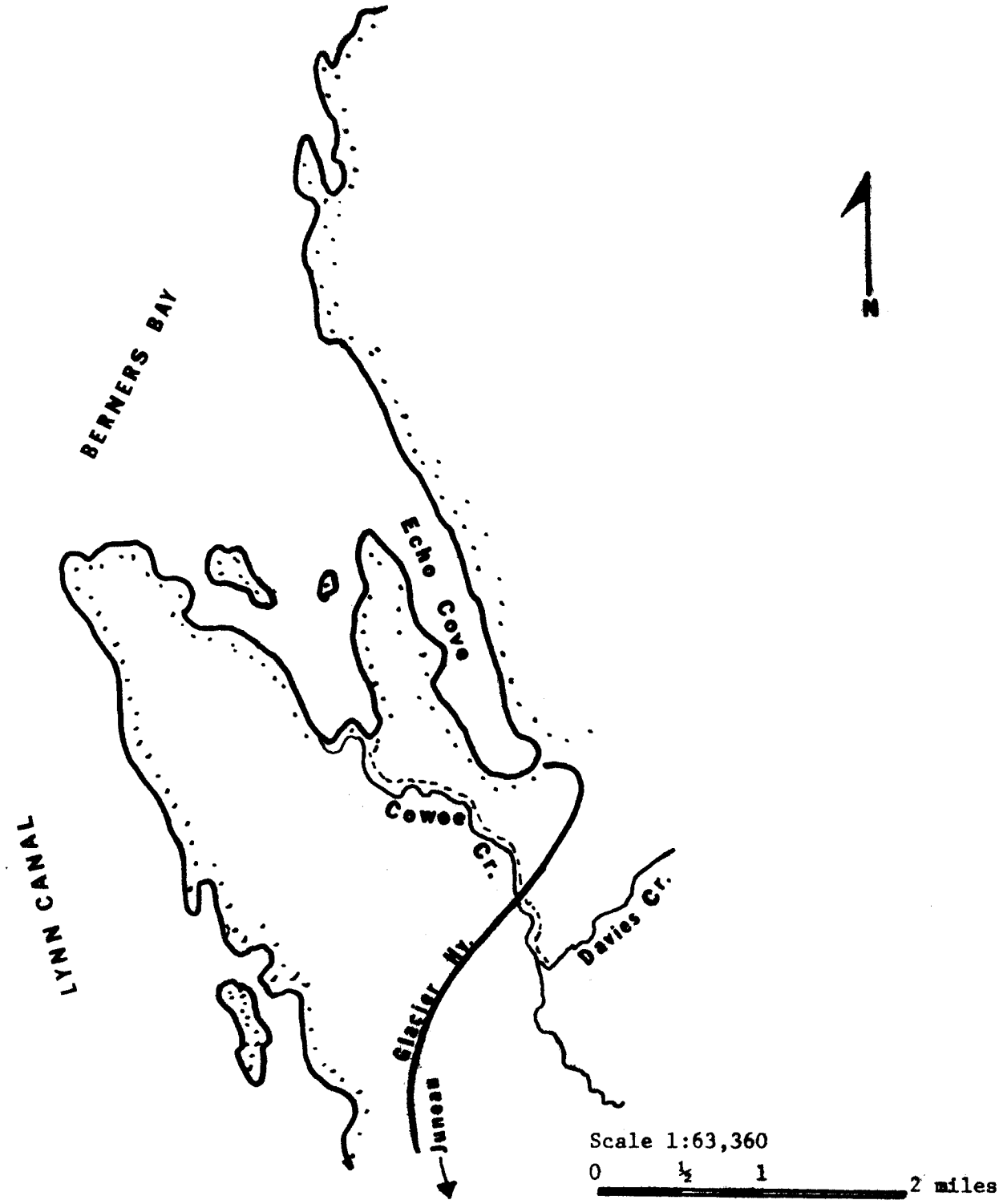

Figure 2. Cowee Creek

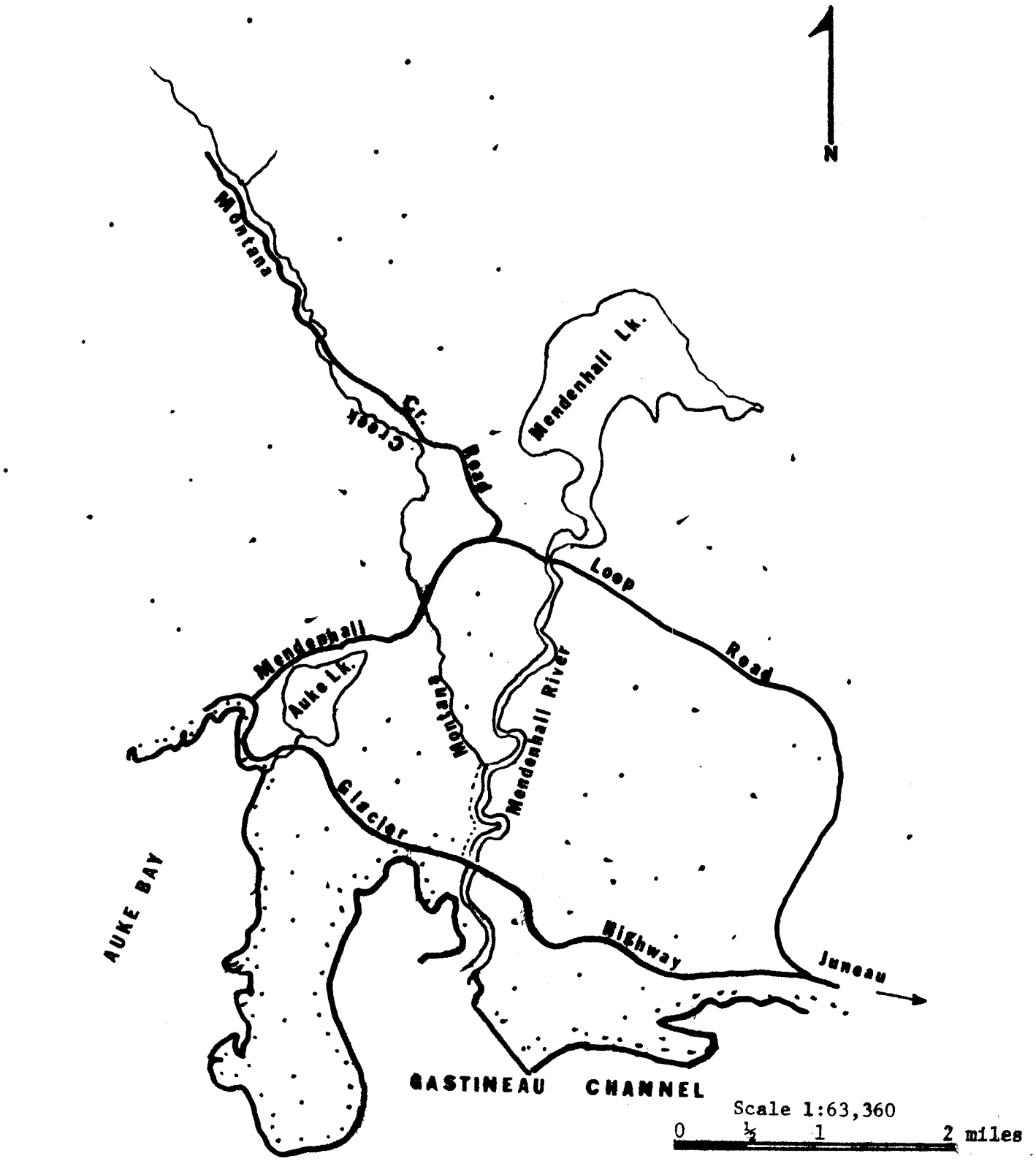

Figure 3. Montana Creek

adjacent to the Mendenhall River with access at the Brotherhood Bridge. The mouth of Montana Creek is reputed to be an excellent fishing area and would be the first area in which migrating steelhead would rest.

Cowee Creek and Montana Creek both have potential as sites for hatchery supported steelhead populations. Of the two, Montana Creek appears to be the best choice as it has the best access, contains more holding water, and runs clear throughout the year.

The two Sitka area streams, Indian River and Salmon Creek, were foot surveyed on August 26, 1975, to determine their potential for introduction of hatchery reared steelhead smolts. Indian River heads in an old glacial valley and flows approximately 16 kilometers to Sitka Sound (Figure 4). Indian River is the source of Sitka's domestic water supply, and a diversion dam is located approximately three kilometers above tide water. This dam is not a total block to migrating fish on normal water levels because a side channel bypasses the dam structure. Fisherman access to Indian River is excellent; a road parallels the lower two kilometers and an excellent Forest Service maintained foot trail runs adjacent to the river above the water diversion dam. There are several excellent steelhead holding holes in the lower two kilometers of Indian River, with additional holding areas above the water diversion structure.

Salmon Creek, located at the head of Silver Bay, is approximately 16 kilometers Southeast of Sitka. Salmon Creek heads in Salmon Lake and flows a little over two kilometers to Silver Bay (Figure 5). Salmon Creek was surveyed from the outlet of Salmon Lake to tide water on August 27, 1975. Salmon Creek was the smallest (4.5-6.0 meters wide) of all streams surveyed and contained only three or four good holding areas for adult steelhead. Access to Salmon Creek is by boat to the head of Silver Bay or by float plane to either Salmon Lake or Silver Bay. An excellent Forest Service foot trail parallels Salmon Creek from tide water to Salmon Lake.

Indian River and Salmon Creek both have potential as future areas for hatchery supported steelhead runs. Indian River appears to have the greatest potential from both the fisherman access and holding water standpoint. Salmon Creek does contain a wild steelhead population so a small plant of hatchery reared steelhead would augment this population.

Steelhead Smolt Out-migration

The seaward out-migration of steelhead smolts through the Petersburg Creek weir began on May 14, 1975, peaked on June 25 and was completed by July 18, 1975 (Table 11). A total of 502 steelhead smolts were trapped during 1975. This number reverses a steady downward trend in smolt numbers and places 1975 behind 1972 in total production (Figure 6).

With decrease in the number of out-migrant smolts, the average size of the smolts increased. In 1972 when 1,251 smolts were trapped, the average length was 161 mm. In 1973 the average size increased to 169 mm for the 423 smolts trapped. The 1974 out-migration of only 383 smolts

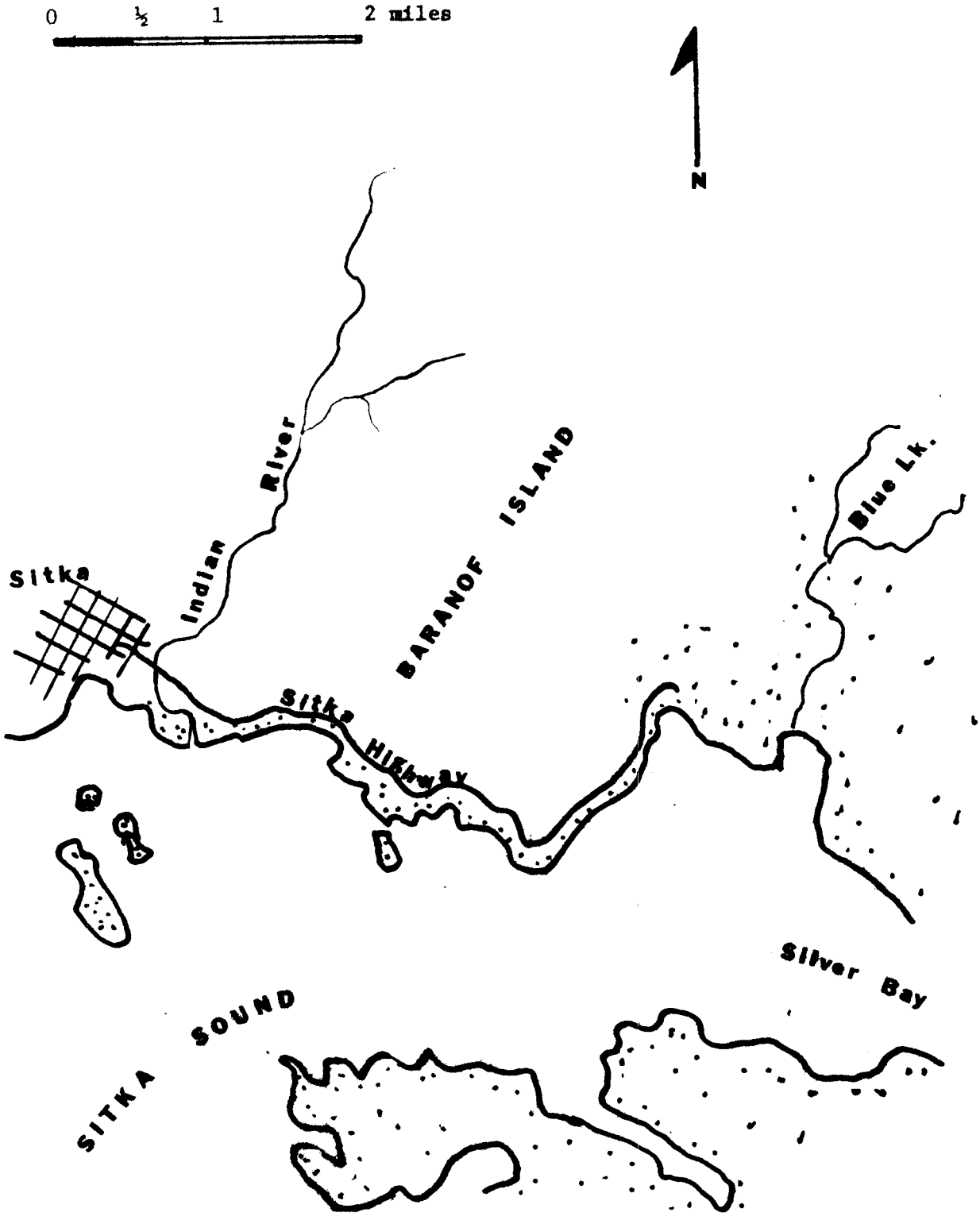

Figure 4. Indian River

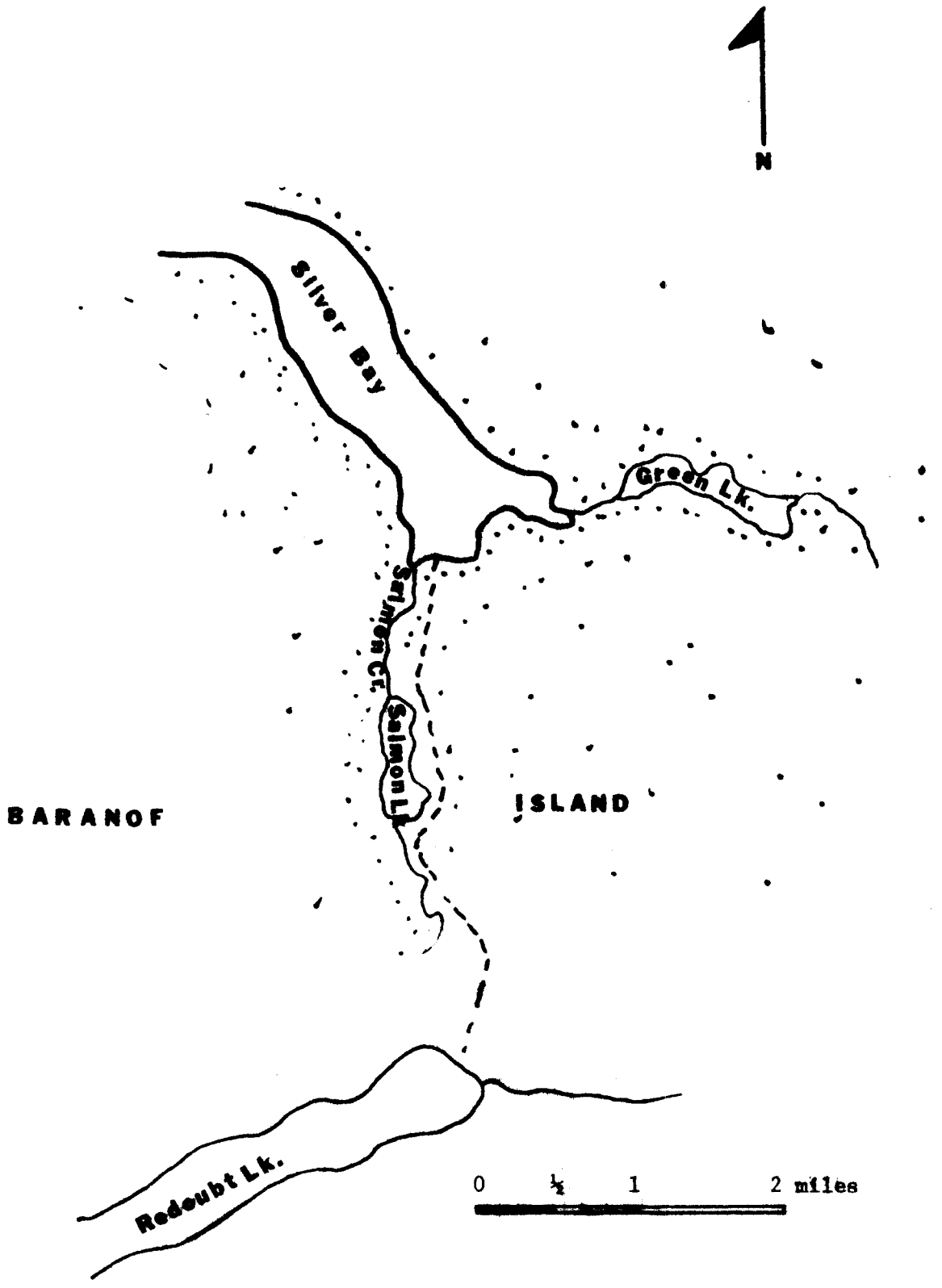

Figure 5. Salmon Creek

averaged 177 mm. The 1975 steelhead smolt out-migration began almost a month later than that recorded in previous years. The 1975 out-migration also peaked four weeks later (Figure 6) and then terminated at approximately the same date as did the 1973 out-migration.

Table 11. Steelhead Trout Smolt Out-Migration by Bi-Weekly Periods, Petersburg Creek - 1975.

Bi-Weekly Period	No.	Fork Length Range in m.m.	Mean Fork Length in m.m.	Percentage of Total
5/11-5/24	7	154-211	180	1.4
5/25-6/7	75	131-276	187	14.9
6/8-6/21	195	142-225	181	38.8
6/22-7/5	203	101-223	172	40.4
7/6-7/19	22	122-180	150	4.4
Total	502	101-276	174	99.9

On June 10, 1975 a total of 8,100 hatchery reared steelhead smolts were released in Petersburg Creek. Of this total, 2,160 were liberated in Petersburg Creek, two and one half kilometers above the weir where Shakey Frank's Creek enters Petersburg Creek. The remaining 5,940 were released just below the weir. The first of the hatchery smolts released at Shakey Frank's Creek were trapped on their out-migration at the weir 24 hours after release. By the end of the out-migration, a total of 286 (11%) of the marked hatchery smolts had been counted through the weir. These smolts ranged in length from 104-162 mm with an average of 142 mm.

Studies of Oregon's Willamette River steelhead (Buchanan 1975) and summer run steelhead from various Washington rivers, (Millenbach 1972) have shown that the highest returns of hatchery steelhead are achieved by releasing the smolts when they have reached an average of 175 mm. The release of smolts less than 140 mm has not resulted in significant returns.

Rearing conditions at the Crystal Lake Hatchery in late 1974 and early 1975 were not optimum; therefore, the steelhead reared for Petersburg Creek were quite small. This may be the reason only 11% of the total number of steelhead smolts released above the weir were enumerated out-migrating through the Petersburg Creek weir. The remaining 89% of the planted steelhead may be still rearing in Petersburg Creek.

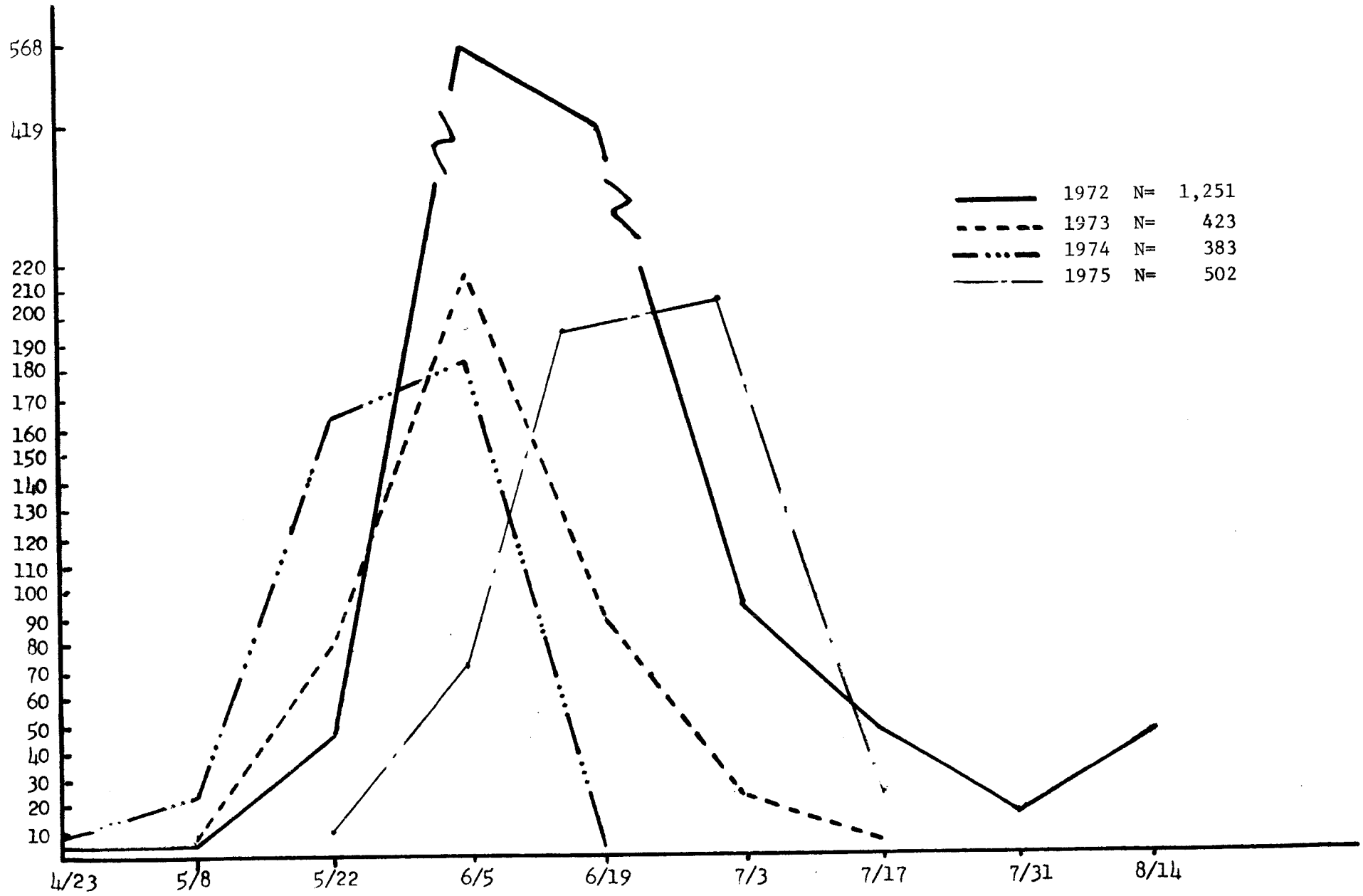

Figure 6. Outmigration of Steelhead Smolts by Bi-weekly Periods, Petersburg Creek, 1972-74.

Steelhead Smolt Age-length Relationships

Age and length data were collected from only eight wild steelhead smolts during the 1975 out-migration. In view of the depressed numbers of out-migrant steelhead smolts, very little sampling was done during 1975. The eight smolt samples were obtained from fish that were dead in the traps or on the weir screens and, therefore, do not represent a random sample of the population as a whole.

Of the eight steelhead smolts sampled 62.5% were age 3, 25.5% were age 1, and 12.5% were age 5. These smolts ranged in size from 164 to 219 mm with an average of 189 mm. The averages are very nearly the same as recorded in 1972 and 1973 when a random sample of the total run was taken.

Other Migrants

Major reconstruction of the Petersburg Creek weir was started in early April 1975 and the weir was complete and operating on the evening of April 23, 1975. The coho salmon, Oncorhynchus kisutch (Walbaum), smolt and overwintering Dolly Vardens, Salvelinus malma (Walbaum), out-migration to saltwater was underway before the weir was fish tight; but it is believed that only small numbers were missed as the ice had been out of Petersburg Creek less than a week before the weir was completed.

The species and numbers of out-migrations from Petersburg Creek in 1975 are presented in Table 12. After the first of August, it was almost impossible to operate the downstream traps due to the large number of dead spawned out salmon floating downstream. Very little downstream movement by any species occurs after the first of August so the traps were converted to trapping in-migrant fish.

Table 12. Number of Out-Migrant Fish by Species and Month, Petersburg Creek Weir 1975.

Month	Cutthroat	Dolly Varden	Steelhead	Coho
April	0	982	1	0
May	209	34,171	21 (27)*	(2211)
June	336	755	75 (451)	(563)
July	175	2	25 (66)	(221)
Aug.	1	0	0	0
Totals	721	35,910	122 (544)	(2995)

* ( ) indicates smolt

The in-migrant traps at the Petersburg Creek weir were complete on April 23, 1975 and the first adult steelhead were captured on April 24, 1974. Only 11 adult steelhead were captured until the first of May, indicating that only small numbers of adult steelhead were in Petersburg Creek before completion of the weir.

Steelhead, cutthroat, Salmo clarki, Dolly Varden, and red salmon, Oncorhynchus nerka, were the only in-migrants enumerated during April, May and June 1975. In-migration of all salmon species peaked in July and August, slowed up somewhat in September and were nearly complete by the termination of the field season in late October (Table 13).

Table 13. Numbers of In-Migrant Fish by Species and Month, Petersburg Creek Weir, 1975.

Month	SH	CT	DV	Red	Pink	Chum	Coho
April	11	0	0	0	0	0	0
May	114	11	0	0	0	0	0
June	10	31	3	40	0	0	0
July	0	30	2,070	699	1,852	190	0
Aug.	0	22	6,699	85	6,357	309	5
Sept.*	0	130	4,273	1	429	18	278
Oct.	0	62	632	0	0	5	104
Totals	135	286	13,677	825	8,638	522	387

* Weir was out of operation for 14 days in early September.

Totals presented in Tables 12 and 13 do not represent the entire run for the species listed. Dolly Varden were passing downstream and adult steelhead upstream before the weir was completed in April. All species passed both upstream and downstream during periods of extreme high water when the weir screens were removed. In addition, undetermined numbers of fish passed upstream during early September when the weir was out of operation for 14 days. From several hundred to several thousand pink salmon, Oncorhynchus gorbuscha, and chum salmon, keta, normally spawn in the inter-tidal area below the weir and are not included in the total counts. The totals presented are the actual counts made during the 1975 weir operation.

DISCUSSION

During the past five years of research at Petersburg Creek, much of the basic life history of the Petersburg Creek steelhead has been learned. The numbers of steelhead entering Petersburg Creek, their timing, age, size, and frequency of spawning and rearing requirements have mostly been determined. In addition, enough basic information has been gathered to begin conducting research on problems of more direct application to management, such as stocking rates for hatchery reared steelhead smolts, habitat improvement, and the establishment of new hatchery supported populations.

Of special importance to management is the finding of the low numbers of steelhead that enter Petersburg Creek annually. Research has shown a steady decline during the past five years of the steelhead population in Petersburg Creek. The cause of this decline is unclear. There apparently are many small subtle factors leading to the decline of adult steelhead numbers. Salmon runs to Petersburg Creek during the same period have shown a decline in abundance and were apparently subjected to the same limiting factors as were the steelhead. The 1975 steelhead smolt out-migration increased for the first time since 1972 so the cycle may have bottomed out.

It is apparent from information gathered at Petersburg Creek, that wild steelhead will be hard to maintain in any number or quality under heavy fishing pressure. The high quality fishing presently available throughout Southeast Alaska is available because the fishing pressure has been light. However, with oil exploration (Yakutat), increased tourism, planned inter-island highways (Prince of Wales Island), and rapid population expansion, maintaining viable fisheries for wild steelhead will be difficult.

Several avenues are open to management to maintain the excellent steelhead fishing in Southeast Alaska. Keeping access difficult to some of the better steelhead streams will ease pressure. Another approach, which has been used extensively in other states, is the supplemental production of steelhead through the use of hatcheries and rearing facilities. The present management goal is to protect and maintain wild stocks of steelhead in their natural environment; however, a foundation must be laid for supplemental hatchery production of steelhead runs.

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